

DEVELOPING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a developing apparatus mounted to an image forming apparatus such as a copier, a printer and the like and, more particularly, it relates to a developing apparatus in which a gap is provided between an image bearing
10 member and a developing sleeve.

Related Background Art

Conventionally, in electro-photographic image forming apparatuses utilizing an electro-photographic image forming process, a process cartridge system in
15 which an electro-photographic photosensitive member (referred to as "photosensitive drum" hereinafter) and process means acting on the electro-photographic photosensitive member are integrated as a cartridge which can be mounted and dismounted with respect to
20 the image forming apparatus has been adopted.

According to this process cartridge, since maintenance of the image forming apparatus can be performed by the user himself without any service man or expert, operability can be enhanced considerably.
25 Thus, the process cartridge system has widely been used in the image forming apparatus. Among the image forming apparatuses in which magnetic toner is used

in the process cartridge, there has been adopted means in which ferromagnetic seal members (referred to as "magnetic seals" hereinafter) are disposed at longitudinal end portions of a developer bearing member (referred to as "developing sleeve" hereinafter) constituting a part of a developing apparatus in a non-contacting relationship to the developing sleeve so that toner is held by magnetic forces of the magnetic seals to prevent the toner from leaking outside the developing apparatus.

Further, for example, as disclosed in Japanese Patent Application Laid-open No. 9-218578, a developer scraping member (referred to as "scraper" hereinafter) having a function for removing or scraping off the toner from a surface of the developing sleeve before the toner held between the developing sleeve and the magnetic seals reaches a developing portion between the photosensitive drum and the developing sleeve and, at the same time, for gathering the removed toner toward a developing area (inside) has been used together with the magnetic seals.

SUMMARY OF THE INVENTION

The present invention aims to further improve the prior art, and an object of the present invention is to provide a developing apparatus in which high

quality images can be obtained stably for a long term.

Another object of the present invention is to provide a developing apparatus comprising a developer bearing member for bearing developer, a spacer
5 provided on a surface at an end portion of the developer bearing member along a longitudinal direction and adapted to maintain a constant gap between an image bearing member for supplying the developer from the developer bearing member and the
10 developer bearing member, a seal member for regulating leakage of the developer toward the end portion of the developer bearing member along the longitudinal direction, and a developer scraping member provided at a portion overlapping with the
15 seal member along the longitudinal direction of the developer bearing member, contacting the developer bearing member, and wherein the developer bearing member also contacts with a surface of the spacer.

The other objects of the present invention will
20 be apparent from the following detailed explanation made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view a main body of an
25 image forming apparatus;

Fig. 2 is a sectional view of a process cartridge A;

Fig. 3 is a schematic view when a developing apparatus according to an embodiment 1 is looked at from a photosensitive member side;

Fig. 4A is a view showing a positional
5 relationship between magnetic seals, scrapers and spacer rollers in the prior art, Fig. 4B is a view showing a positional relationship between magnetic seals, scrapers and spacer rollers in the embodiment 1, and Fig. 4C is a view showing a positional
10 relationship between magnetic seals, scrapers and spacer rollers in an embodiment 2;

Fig. 5 is a sectional view of a developing apparatus taken along the line 5-5 in Fig. 3; and

Fig. 6 is a sectional view taken along the line
15 6-6 in Fig. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, embodiments of the present invention will be explained with reference to the accompanying
20 drawings.

(Entire construction)

Fig. 1 is a sectional view showing a condition that a process cartridge mounting thereon a developing apparatus according to the present
25 invention is mounted to a main body of an image forming apparatus.

The image forming apparatus serves to form an

image on a recording medium by an electro-
photographic image forming process. As shown in Fig.
1, a toner image is formed on a drum-shaped electro-
photographic photosensitive member (photosensitive
5 drum) 1 as an image bearing member. In synchronous
with formation of the toner image, a recording medium
11 set on a sheet feeding tray 10 is conveyed by
convey means comprising a pick-up roller 12, a convey
roller and the like.

10 Then, the toner image formed on the
photosensitive drum 1 provided in a process cartridge
A is transferred onto the recording medium 11 by
applying voltage to a transferring roller 14 as
transferring means. Thereafter, the recording medium
15 11 to which the toner image was transferred is
conveyed to fixing means while being guided by a
guide plate. The fixing means are constituted by a
fixing roller 16 including therein a heater and a
pressurizing roller 15 for urging the recording
20 medium 11 against the fixing roller 16 to convey the
recording medium and serve to fix the toner image to
the recording medium 11 by applying heat and pressure
to the recording medium 11. The recording medium 11
to which the toner image was fixed is conveyed by
25 discharge rollers to be discharged onto a discharge
portion 17.

(Process cartridge)

Next, the process cartridge will be explained with reference to Fig. 2.

The process cartridge A includes the image bearing member 1, charging means 8, developing means 7 and cleaning means 9. The photosensitive drum 1 as the image bearing member having a photosensitive layer is rotatably driven by a motor provided in the main body of the image forming apparatus and a surface of the photosensitive drum is uniformly charged by application of voltage from the charging roller 8 as the charging means. Then, laser beam light corresponding to image information from an optical system 18 is illuminated onto the photosensitive drum 1 through an exposure opening portion, thereby forming an electrostatic latent image on the photosensitive drum 1, and the electrostatic latent image is developed by using toner by means of the developing apparatus 7 to visualize the electrostatic latent image as the toner image. Here, the charging roller 8 is contacted with the photosensitive drum 1 to charge or electrify the photosensitive drum 1.

Further, the developing apparatus 7 serves to supply the toner to a developing area of the photosensitive drum 1 thereby to visualize the latent image as the toner image.

The developing apparatus 7 includes a toner

containing portion 7e, a developing sleeve (developer bearing member) 7b and the like. Within the developing sleeve 7b, a magnet 4 is fixedly provided along a longitudinal direction of the developing sleeve and the developing sleeve 7b is rotated around the magnet. The toner (magnetic toner) in the toner containing portion 7e is supplied to a developing chamber 7a by a conveying member, where the toner is adhered to a surface of the developing sleeve by a magnetic force of the magnet 4. Tribo-electric electrifying charges are applied to the toner by a developing blade 7c. Thereafter, by the rotation of the developing sleeve, the toner is carried to a developing area opposed to the photosensitive drum 1, where the toner is transferred to the photosensitive drum 1 by developing bias, thereby developing the electrostatic latent image.

By applying voltage having polarity opposite to polarity of the toner image to the transferring roller 14, the toner image formed on the photosensitive drum 1 is transferred onto the recording medium 11. Incidentally, after the toner image was transferred, transferring residual toner remaining on the photosensitive drum 1 is removed by the cleaning means 9 and the removed toner is collected into a waste toner reservoir 9a.

Various parts such as the photosensitive drum 1

and the like are accommodated in a cartridge frame constituted by joining a toner developing frame 7d and a toner containing frame 7f and a cleaning frame 2 to form a unit as the process cartridge A. That is
5 to say, the toner developing frame 7d and the toner containing frame 7f are fused together to form the toner containing portion 7e and the developing chamber 7a, and the developing sleeve 7b and the developing blade 7c are attached to the developing
10 chamber to constitute the developing apparatus. The process cartridge A is constituted by rockably connecting the toner developing frame 7d to the cleaning frame 2.

(Developing apparatus)

15 Next, the developing apparatus according to the present invention will be explained with reference to Figs. 3 and 5.

Fig. 3 is an appearance view of the developing apparatus 7 looked at from a side of the
20 photosensitive drum 1 and Fig. 5 is an enlarged view of the developing chamber of the developing apparatus and therearound. As shown in Fig. 3, spacer rollers 3a and 3b for maintaining a constant gap SD between the photosensitive drum 1 and the developing sleeve
25 7b are rotatably mounted on longitudinal end portions of the developer bearing member 7b. The developing blade 7c abuts against the developing sleeve 7b along

a longitudinal direction of the developing sleeve to regulate the toner to a predetermined thickness and to apply tribo-electricity to the toner. Further, in the vicinity of the longitudinal end portions of the developing sleeve 7b, along a circumferential direction of the developing sleeve, there are provided magnetic seals 5a and 5b which are spaced apart from an outer circumferential surface of the developing sleeve 7b by a predetermined distance or gap, so that the toner is held by magnetic forces of the magnetic seals to prevent the toner from leaking outside. Further, scrapers 6a and 6b are provided in such a manner that the scrapers are overlapped with the magnetic seals in the longitudinal direction of the developing sleeve and the scrapers extend outside the magnetic seals 5a and 5b and inside the spacer rollers 3a and 3b in the longitudinal direction of the developing sleeve.

The scrapers 6a and 6b are made of resin and are provided at positions where they are overlapped with the magnetic seals 5a and 5b in the longitudinal direction of the developing sleeve and are positioned in the vicinity of downstream end portions of the magnetic seals in a rotational direction of the developing sleeve. The toner held between the developing sleeve 7b and the magnetic seals 5a, 5b is removed from the surface of the developing sleeve 7b

by the scrapers 6a and 6b before the toner reaches the developing portion between the developing sleeve and the photosensitive drum 1 by the rotation of the developing sleeve 7b. Each of contact portions
5 between the scrapers 6a, 6b and the developing sleeve 7b has a shape in which the scraper is contacted with a more downstream side in the rotational direction of the developing sleeve 7b as the scraper advances toward an image area side (inside) in the
10 longitudinal direction of the developing sleeve (i.e. a shape in which the removed toner is directed toward the image area side (inside) in the longitudinal direction of the developing sleeve by the rotation of the developing sleeve 7b). Namely, a leading or tip
15 end of each scraper is cut obliquely. Incidentally, the spacer rollers 3a and 3b are disposed outside the magnetic seals 5a and 5b in the longitudinal direction of the developing sleeve. With this arrangement, adhesion of the toner to the spacer
20 rollers 3a and 3b is suppressed.

(Scrapers according to embodiment 1)

Now, the scrapers according to an embodiment 1 (first embodiment) of the present invention will be explained.

25 First of all, a positional relationship between the scrapers, magnetic seals and the spacer rollers in the longitudinal direction of the developing

sleeve will be explained with reference to Figs. 4A to 4C. As shown in Fig. 4A, contact portions 6c' and 6d' of conventional scrapers 6a', 6b' to the developing sleeve are merely overlapped with the magnetic seals 5a and 5b. To the contrary, as shown in Fig. 4B, contact portions 6c and 6d of scrapers 6a and 6b according to the first embodiment to the developing sleeve are overlapped with the magnetic seals 5a and 5b and extend in non-image areas to be contacted with abutment portions 3c and 3d of the spacer rollers 3a and 3b to the photosensitive drum 1. Here, although it is desirable that the contact portions 6c and 6d of the scrapers 6a and 6b to the developing sleeve are contacted with the whole areas of the abutment portions (3c and 3d) of the spacer rollers 6a and 6b to the photosensitive drum 1 as shown in Fig. 4B, such contact portions may be provided to be further contacted with portions where the toner is apt to be scattered. (Among the abutment portions of the spacer rollers to the photosensitive drum, generally, at the image area side (inside of the longitudinal direction of the developing sleeve), the toner is apt to be scattered.) In each of the scrapers according to this embodiment, a leading end thereof is cut obliquely from a magnetic seal corresponding position to a spacer roller corresponding position.

Fig. 6 is a sectional view taken along the line 6-6 and also showing the photosensitive drum 1. The spacer rollers are rotatably attached with respect to the developing sleeve. During development, when the developing sleeve 7b is rotated, the spacer rollers 3a and 3b are rotated to follow the rotation of the photosensitive drum or to follow the rotation of the developing sleeve in dependence upon a force relationship between friction forces f_1 acting on the abutment portions between the photosensitive drum and the spacer rollers 3a and 3b, friction forces f_2 acting between inner peripheries of the spacer rollers and an outer periphery of the developing sleeve and friction forces f_3 acting on contact portions between the scrapers and the spacer rollers. Namely, as shown in Fig. 6, during the development, the spacer rollers are rotated in a direction while following the rotation of the photosensitive drum 1 or the developing sleeve 7b and contact the scrapers before they reach the developing portion between the photosensitive drum 1 and the developing sleeve 7b. Thus, if the toner is adhered to the abutment portions of the spacer rollers 6a and 6b to the photosensitive drum from the ambient atmosphere, before the spacer rollers reach the developing portion between the photosensitive drum 1 and the developing sleeve 7b, since the toner is removed by

the scrapers 6a and 6b, the toner does not remain on the abutment portions of the spacer rollers to the photosensitive drum.

Namely, the scrapers according to the present invention have not only the conventional scraper function for removing the toner coming out of the spaces between the magnetic seals and the developing sleeve due to the rotation of the developing sleeve but also a function for removing the toner from the surfaces of the spacer rollers even if the toner scattered from the developing portion or the ambient atmosphere is adhered to the spacer rollers 3a and 3b. As a result, the distance between the developing sleeve 7b and the photosensitive drum 1 can always be held constant, with the result that high quality images can be maintained for a long term.

Further, in the illustrated embodiment, separate members for removing the toner adhered to the spacer rollers 3a and 3b as disclosed in Japanese Patent Application Laid-open No. 9-325617 are not used, but, since the invention in which the contact portions of the conventional scrapers to the developing sleeve 7b are extended in an axial direction of the developing sleeve 7b is provided, the manufacturing cost can be suppressed considerably. (Second embodiment)

Next, an embodiment 2 (second embodiment) of

the present invention will be explained with reference to Fig. 4C.

In the second embodiment, as shown in Fig. 4C, in addition to conventional scraping or removing portions 6e, at least one or more second removing portions 6f are provided. The removing portion 6e and the second removing portion 6f are integrally molded from resin. That is to say, it is designed so that a notch is formed between the removing portion 6e and the second removing portion 6f.

As shown in Fig. 4C, the second removing portions are disposed nearer the non-image areas than the conventional removing portions 6e in the longitudinal direction of the developing sleeve 7b and are contacted with the respective abutment portions 3c and 3d of the spacer rollers 3a and 3b to the photosensitive drum 1. Here, as shown in Fig. 4C, although it is desirable that the second removing portions 6f are contacted with the whole areas of the abutment portions (3c and 3d) of the spacer rollers 3a and 3b to the photosensitive drum 1, such removing portions may be provided only at positions where toner is apt to be scattered. (Among the abutment portions of the spacer rollers to the photosensitive drum, generally, at the image area side, the toner is apt to be scattered.) When the developing sleeve 7b is rotated during the development, as described in

the embodiment 1, the spacer rollers 3a and 3b are rotated while contacting the second removing portions 6f of the scrapers 6a and 6b.

Thus, even if the scattered toner is adhered
5 onto the spacer rollers 6a and 6b, the toner is removed by the second removing portions of the scrapers 6a and 6b promptly, and, therefore, the toner is not remaining on the spacer rollers.

Incidentally, different from the first
10 embodiment, in the second embodiment, since the notch is formed between the removing portion 6e and the second removing portion 6f, the working for bending the respective removing portions toward any directions can easily performed so that abutment
15 angles of the respective removing portions against the surfaces from which the toner is to be removed can easily be optimized, with the result that the performance for removing the toner from the surfaces from which the toner is to be removed can be enhanced.
20 In the second embodiment, leading ends of the removing portions are cut obliquely with respect to the longitudinal direction of the developing sleeve and leading ends of the second removing portions 6f are cut in parallel with the longitudinal direction
25 of the developing sleeve.

As mentioned above, in the scraper according to the present invention, in addition to the

conventional scraper function, a function for removing the toner scattered from the developing portion and/or the ambient environment and adhered to the spacer rollers 3a and 3b can be achieved with low
5 cost. As a result, the distance between the developing sleeve 7b and the photosensitive drum 1 can always be held constant, with the result that high quality images can be maintained for a long term.

Further, since the second removing portions
10 (6f) are provided independently from the conventional removing portions (6e), contact conditions of the respective removing portions to the developing sleeve and contact condition of the respective removing portions to the spacer rollers can be optimized
15 independently.

Further, similar to the embodiment 1, separate members for removing the toner adhered to the spacer rollers 3a and 3b are not used, but, by integrally forming the second removing portions with the
20 conventional scrapers, the manufacturing cost can be suppressed considerably.

As apparent from the above-mentioned explanation, according to the present invention, the high quality images can be obtained stably for a long
25 term.

The present invention is not limited to the above-mentioned embodiments, but various alterations

and modifications can be made within the scope of the invention.